

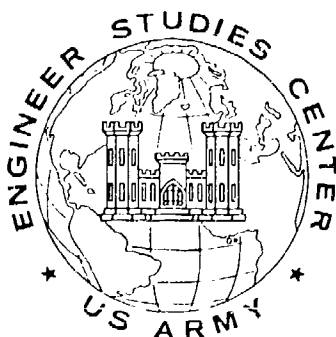
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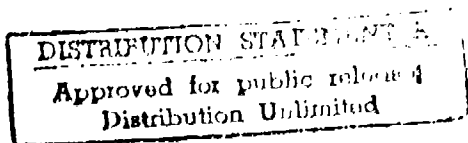
ENGINEER ECHELONS-ABOVE-DIVISION SUPPORT OF  
LIGHT AND MOTORIZED DIVISIONS



Prepared by  
Engineer Studies Center  
US Army Corps of Engineers

June 1987

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<p>This study analyzes the worldwide requirements of the engineer units of the US Army's echelons-above-division (EAD) to support the requirements generated by light and motorized divisions. The monograph determines the type and quantity of EAD units required to support lightweight divisions in each of four theaters. The study examined the equipment mix and squad-to-equipment ratio of lightweight EAD units initially required of these rapid-response divisions. The report concludes by briefly outlining the advantages and disadvantages of several of the division's bridging alternatives. The US Army Engineer Studies Center (ESC) sponsored this effort to compile in one document the results of a family of wartime ESC studies that dealt directly or indirectly with the engineer requirements and capabilities of lightweight divisions.</p>				
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## EXECUTIVE SUMMARY

This study, sponsored by the US Army Engineer Studies Center (ESC), analyzes the worldwide requirements for engineer units of echelons-above-division (EAD) to support the Army's new light and motorized infantry divisions. This report is essentially an overview of the force structure needed to support the Army's new concepts in lightweight fighting forces. This report relies on and integrates the results of previous wartime ESC studies that dealt directly or indirectly with the engineer requirements and capabilities of lightweight divisions. Applying those results to conditions across four separate theaters, it indicates the amount and type of engineer EAD support that lightweight divisions need in order to fight in most worldwide contingency areas. Those were adjusted to represent the availability of the new engineer equipment and explosives expected to be fielded in the 1990s.

This study also concluded that although existing or proposed engineer units can meet the follow-on engineer requirements generated by the Army's light and motorized divisions, they are unable to meet rapid-response requirements. ESC found that each division needs a new light corps battalion (in addition to its organic divisional battalion) to support its rapid-response requirements. In addition, a light infantry division needs another three engineer EAD battalion-equivalents to satisfy follow-on combat support requirements generated within the division area. Also, a motorized infantry division needs from three to 10 additional battalion-equivalents, depending on its theater of operation, to satisfy follow-on combat support requirements within the division area. Finally, each division, whether light or motorized, will also need a normal complement of engineers (i.e., a division-slice) to provide engineer support in the corps rear area and in the area behind the corps rear boundary (i.e., the RCZ or COMMZ).

ESC recommends adopting a new, light corps engineer battalion design to meet the high-priority, rapid-response needs of both lightweight divisions. This design -- a modified version of the Table of Organization and Equipment 5-445 -- would have two centralized equipment companies sharing 60 items of equipment and two additional squad-only companies, with a total of 18 squads each. These criteria should limit the battalion to only 500 soldiers and 50 C-141B sorties. Four such light corps engineer battalions are recommended for future force structure. These new units can be formed from existing heavy engineer EAD units.

Finally, ESC recommends using three light-bridge detachments to support deployments of lightweight divisions to contingencies in underdeveloped countries. This urgently needed detachment should use currently available inventory bridges; however, a future version of the detachment should use new bridging concepts so that the unit can be transported in just three C-141B aircraft.

ENGINEER ECHELONS-ABOVE-DIVISION  
SUPPORT OF LIGHT AND MOTORIZED DIVISIONS

I. INTRODUCTION

1. Purpose. To analyze the worldwide requirements for engineer units of the US Army echelons above division (EAD) to support light and motorized infantry divisions forward of the division rear boundary.

2. Scope. This monograph:

a. Determines the type and quantity of EAD units required to support lightweight divisions in each of four theaters.

b. Examines the equipment mix and squad-to-equipment ratio of lightweight EAD units initially required of these rapid-response divisions.

c. Briefly outlines the advantages and disadvantages of several EAD bridging alternatives.

3. Background. In late 1984, the US Army Engineer Studies Center (ESC) began discussions with the US Army Development and Employment Agency (ADEA) that led to ADEA sponsoring two ESC studies of the Army's newest lightweight divisions: the 9th Infantry Division (Motorized) (9ID[MTZ]) and the light infantry division (LID). (Note: In this report, the term "lightweight" will always refer only to these two divisions.)

a. ESC completed its study of the 9ID(MTZ) in December 1985. It recommended mission and equipment-mix changes to four engineer EAD units. Since these recommendations were based on two scenarios and one specialized division, some in the planning community perceived that the study was too narrow in scope to justify broad changes in the engineer EAD force structure. The 9ID(MTZ) analysis, however, drew from data obtained during previous ESC analyses of the III, V, and VII US Corps in Europe.<sup>1</sup> Those data confirmed ESC's hypothesis that the equipment mix required to back up the motorized

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<sup>1</sup>Analysis of III Corps Combat Engineer Wartime Requirements (US Army Engineer Studies Center [ESC], December 1984); Analysis of VII Corps Combat Engineer Requirements, two volumes (ESC, March 1983); and Analysis of V Corps Combat Engineer Wartime Requirements (ESC, December 1983).

division is similar to the engineer EAD requirements of other divisions in other theaters.

b. In its December 1986 study of the LID concept, ESC's data base on light forces was expanded to three theaters. Three of the four engineer EAD units examined previously for the 9ID(MTZ) study were again looked at for mission and equipment-mix changes. Two of these three engineer EAD units were specifically created to support lightweight divisions. However, these two units were conceptual and not in the force structure. ESC concluded that these conceptual units must be fielded before the Army's new lightweight divisions can meet contingency requirements generated in all but the Korean theater.

c. For this most recent analysis, ESC reviewed and combined the results of two corps-level studies recently completed by ESC of engineer requirements in Korea and Southwest Asia (SWA). Those results and the results of ESC's division-based analyses provided an excellent data base of scenarios from which to examine both the motorized division and the LID concept in all of their major force projections. ESC believed it would be useful to the engineer community to consolidate the EAD requirements of theaters worldwide, and to develop allocation rules for the Army's new motorized and light divisions.

d. This monograph was sponsored by ESC and was informally staffed with the US Army Engineer School. Although no formal concurrence with ESC's results was obtained from the school, many of the school's comments were incorporated into this final report.

#### 4. Assumptions/Limitations and Their Significance.

a. LIMITATION: This monograph presents only unclassified results. SIGNIFICANCE: The rationale for some solutions are available by referring to the ESC's classified Korea and SWA studies.<sup>2</sup> Calculations to determine total force requirements are also omitted, but can be determined by the user by multiplying the unclassified division-theater allocation rule by the appropriate classified assignment of each deployable lightweight division and summing the results.

b. ASSUMPTION: The 9ID(MTZ) and the five LIDs are the only lightweight divisions considered by this analysis. SIGNIFICANCE: The engineer EAD

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<sup>2</sup>Engineer Assessment Korea: Forward Combat Zone Analysis (ESC, July 1986) and Engineer Assessment, Southwest Asia, three volumes (ESC, draft summer 1987).

force structure for the 82d Airborne Division and the 101st Air Assault Division are omitted. Since these two divisions are not new, their engineer EAD force has been studied before and the engineer force structure is assumed to be adequately provisioned for their needs.

c. ASSUMPTION: Recommended changes do not increase the personnel size of the current engineer EAD force nor will unreasonable equipment costs be added. SIGNIFICANCE: Recommended changes are practical solutions that can be implemented in the near future.

5. Methodology. This report is essentially an overview of the force structure that will be needed to support the Army's new concepts in lightweight fighting forces. The general methodology compiles the results of a family of wartime ESC studies that deal directly or indirectly with the engineer requirements and capabilities of lightweight divisions. This report integrates those results, and in applying them to conditions across four separate theaters, indicates the amount and type of engineer EAD support lightweight divisions need to fight in most worldwide contingency situations.

a. The studies which provided the source data for this analysis represent about 17 man-years of analytic effort. Each of these detailed studies began by identifying specific, but representative, scenarios. These scenarios incorporated assumptions about combat conditions and the best accepted method for portraying tactical doctrine. Details about engineer task requirements were then calculated, by task, for each scenario time period. Readers who wish to review the detailed calculations and results on which this overview report is based should consult:

(1) Engineer Analysis of the 9th Infantry Division (Motorized), (ESC, December 1985) and Engineer Analysis of the 9th Infantry Division (Motorized) -- Scenario Descriptions (ESC, November 1985).

(2) Engineer Analysis of the Light Infantry Division (ESC, December 1986) and Engineer Analysis of the Light Infantry Division -- Scenario Description (ESC, December 1986).

(3) Engineer Assessment, Korea: Forward Combat Zone Analysis (EAK-FCZ) (ESC, July 1986).

(4) Engineer Assessment, Southwest Asia (EASWA), three volumes (ESC, draft summer 1987).

b. Figure 1 lists which ESC study results were used to determine, by theater, the best unit and force structure for the lightweight divisions.

c. The results of the studies listed in Figure 1 were based, in some cases, on different sets of assumptions. Therefore, for this analysis, the results were adjusted to characterize uniform conditions. For example, this monograph is concerned with future conditions, when new engineer equipment, mines, and explosives are available. Figure 2 shows that both ESC's SWA and Korea studies are current-timeframe studies that must be adjusted to the future.

#### STUDIES USED IN THEATER ANALYSIS

Theater	ESC Study
SWA	EASWA & 9ID(MTZ)
Korea	EAK-FCZ
Latin America	LID
Europe	LID & 9ID(MTZ)

Figure 1

#### THEATER CONDITIONS BY STUDY

Theater	ESC Study	Timeframe	New Engineer:	
			Equipment	Class V
SWA	9ID(MTZ)	1990	Yes	Yes
	EASWA	1986	No	No
Korea	EAK-FCZ	1985	No	No
Latin America	LID	1992	Yes	Yes
Europe	LID	1992	Yes	Yes
	9ID(MTZ)	1990	Yes	Yes

Figure 2

d. All four of ESC's earlier studies of the LID or motorized division shared the same requirements methodology. Therefore, the studies' results can be directly compared. Figure 3 shows the priority groups that were used by ESC to rank results in all four studies. To determine force structure rules, these priorities were divided into two categories: crucial-combat requirements and sustainability requirements.

#### PRIORITY GROUPS

Short Title	Implications of Nonsupport
Vital	Jeopardizes the existence of the division; high loss of life and early defeat of the division.
Critical	Failure of division operations; increased probability of defeat; paramount to success in pivotal situations.
Essential	Short-term degradations in sustainability; significant equipment and material losses (may be deferred 1-2 weeks).
Necessary	Long-term degradation in sustainability; moderate equipment and material losses (may be deferred up to 4 weeks).

Figure 3

(1) The crucial-combat category normally includes all vital and critical priority group requirements. Characteristically, the crucial-combat requirements are non-deferrable engineer tasks that support the maneuver elements of a division when it is engaged in combat operations. The crucial-combat tasks that cannot be accomplished by a divisional engineer battalion should be accomplished by engineer EAD units that either accompany the initial division deployment, or arrive as close to that closure as possible.

(2) The sustainability category normally includes essential and necessary requirements. Sustainability requirements are engineer tasks that support the combat support units and combat service support units. These tasks can be deferred, but must eventually be done sometimes (2 to 4 weeks after combat has begun) by the remainder of the engineer EAD force.

e. Crucial-combat requirements define the capability needed by the division engineer battalion and those EAD units supporting the division's maneuver elements. Sustainability combat requirements define the capability needed in the general supporting EAD force. The combined requirements of these two broad categories define the capability required of the total force. For this and the other source ESC studies, these requirements only consider the area forward of the division rear boundary.

## II. DIVISION DESCRIPTIONS

6. General. The motorized infantry division and the LID share some common operational concepts.<sup>3,4</sup> Both divisions have fewer personnel than armored and mechanized divisions and all their equipment is configured to fit inside the C-141B airplane. They both require secure landing areas in or near the contingency lodgement area, thereby eliminating the need for organic engineer capability to construct airfields or do major airfield repairs. (Securing a lodgement area is a possible mission, but will normally be left to another service or to other Army divisions). The divisional units are provided with 48-hour basic loads of supply. As a result, the units are initially self-sufficient, but have little staying power. They soon require EAD augmentation, especially for logistical functions. Although each division can be employed in Europe, Europe is a secondary mission, there the divisions will serve in an economy-of-force role or participate in rear area combat operations. The primary mission of each division is to deploy rapidly to a crisis area and fight using its specialized capabilities.

7. Motorized Infantry Division. There is only one motorized infantry division: the 9ID(MTZ), which is stationed at Fort Lewis, Washington. The division's mission is centered on destroying high-value targets. To aid this mission, the divisional aviation brigade provides maneuver support, enhanced combat support, and combat service support.<sup>5,6</sup> The division's area of operation (AO) could be large, open, and roadless. This type of terrain allows the division to maximize its inherent mobility and firepower while staying alive with its thin-skinned vehicles. However, such terrain is only found in the SWA theater. In other theaters, the suitable employment of the 9ID(MTZ) is limited to an economy-of-force role or to participation in rear area combat operations.

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<sup>3</sup>Operational Concept -- 9th Infantry Division (Motorized), Part I, "The Division Concept" (US Army Development and Employment Agency [ADEA], 2 April 1984).

<sup>4</sup>US Army Operational Concept: The Light Infantry Division (US Army Combined Arms Combat Development Activity [CACDA], 28 June 1984).

<sup>5</sup>Operational Concept -- 9th Infantry Division (Motorized), Part I, "The Division Concept"; Part II, "Unit Concepts"; Part III, "Equipment and Systems Concept" (ADEA, 2 April 1984).

<sup>6</sup>US Army Operational Concept: The Light Infantry Division (CACDA, 28 June 1984).

The design movement goal for this division is 1,000 C-141B sorties, but the division now requires over 1,300 sorties to deploy.

8. Light Infantry Division. The US Army has five light infantry divisions. The only reserve component LID is the 29th LID, which was formed from separate existing units. Two of the four active LIDs (the 7th and 25th) were formed essentially by conversion. The others (the 6th and 10th) are newly activated. The LID's primary mission is to fight against light enemy forces. The division fights dismounted and operates best in closed terrain and at night; it can only engage heavy enemy forces in closed terrain. The LID has an aviation brigade which enhances its ability to maneuver and provide all forms of helicopter transport. The LID's capabilities also allow the LID to conduct rear area and urbanized military operations. Therefore, the LID can be deployed properly in all of the four theaters considered in this analysis. This division's actual movement goal is the design objective of about 500 C-141B sorties.

9. Organic Engineer Battalions. The engineer battalions organic to the motorized division and the LID also share some common characteristics. Both battalions are small and have limited earthmoving equipment -- only the Armored Combat Earthmover (ACE) and Small Emplacement Excavator (SEE). Both units use cargo trucks instead of the dump trucks to move project materials. Both employ a few small squads. Neither unit can construct an airfield. This is consistent with the division's concept of operation, which states that the division will usually be deployed into a secure landing area. Figure 4 compares key attributes of each engineer battalion.

a. The engineer battalion in the motorized division maintained the concept of decentralized equipment, and spread its 18 ACEs among its four line companies. The battalion's 24 SEEs were spread among all five companies. As a result, the SEE became a second squad vehicle and the primary source of squad hand tools. The battalion also has an engineer company for each maneuver brigade plus the division support command (DISCOM), which provides an engineer platoon for each maneuver battalion. To accommodate these changes, the battalion's platoons are composed of only two squads each, rather than the traditional three. ESC's 91D(MTZ) study recommended the division decrease the number of bridges and SEEs in its inventory, and make corresponding increases

## ENGINEER LIGHT FORCE BATTALIONS\*

	Motorized Division	Light Division
Personnel strength	476	290
C-141B sorties	55	16
Line companies	4	3
Line platoons	10	6
Squads	20 (2 per platoon)	18 (3 per platoon)
Squad size	7	8
Squad vehicle	HMMWV & SEE	--
ACE total	18	6
SEE total	24	18
5-ton cargo trucks	32	8
Light Assault Bridge	10 (conceptual)	--
MICLICs	10	--
Volcano mine system	6	-- (3 in BOIP)

\*HMMWV = High Mobility Multipurpose Wheeled Vehicle; MICLIC = Mine Clearing Line Charge; BOIP = Basis of Issue Plan

Figure 4

in the number of trucks and ACEs in its Table of Organization and Equipment (TOE).

b. The engineer battalion organic to the LID is the smallest engineer battalion and the only engineer battalion where there is no squad vehicle. Engineer equipment is centralized in the headquarters and headquarters company (HHC), leaving the line companies with only a few wheeled vehicles. The battalion has no bridge capability. The engineers have three line companies to support three infantry brigades, one aviation brigade, and the DISCOM. With two platoons per engineer company, this structure provides only six engineer platoons to support nine infantry maneuver battalions. The engineers are therefore sent where the work is most important, since continuous habitual, association is not possible at either maneuver brigade or battalion levels. ESC's ELID study recommended this unit should have more ACEs and fewer SEEs.

### III. EAD FORCE STRUCTURE REQUIREMENTS

10. General. This section describes the EAD units ESC believes are needed to support the Army's new light or motorized divisions. Each recommendation is organized by theater, and explains the EAD engineer force and the allocation rule for the light or motorized division operating in that theater. The allocation rules are based only on the division area and do not include engineer requirements in the remainder of the forward combat zone or communication zone that are needed to support the committed light infantry or motorized division. As ESC has defined it, the EAD engineer force automatically excludes the organic divisional engineer battalion. The engineer EAD force is therefore the total force required within the division area minus the divisional engineer battalion; this force is always described in terms of battalion equivalents. A theater summary paragraph follows each theater recommendation.

11. Candidate EAD units. All four of ESC's studies concerning the Army's new light infantry and motorized divisions assumed that each division could be supported by up to four kinds of engineer EAD units. The composition of the units ESC considered as candidates for EAD support varied with the scenario under consideration. Figure 5 lists these candidate units both by the numbers they are now assigned under H-series MTOE, and by their new numbers under the L-series TOE.

a. ESC considered two heavy units suitable for the EAD support of light or motorized units: the combat support equipment (CSE) company and wheeled corps engineer battalion. These units are classified as heavy for two reasons -- they possess large types and quantities of earthmoving equipment, and they deploy best by ship because some of their equipment cannot fit into a C-141B. Because heavy units will deploy later, they are more appropriately used to support the sustainability force in most theaters. In Europe, they can be forward deployed so they will be available and in-place when the lightweight divisions arrive. Both the CSE company and the wheeled corps battalion exist in the active and reserve components.

b. ESC also considered two light units suitable for EAD support: the light equipment company and the light engineer corps battalion. These units are classified as light because they are small, have few types and

# CANDIDATE ENGINEER EAD UNITS

Old TOE (New TOE)	Unit Title	Existing	Category
5-58H4 (5-423L)	Engineer Company, Combat Support Equipment Engineer Company, Combat Support Equipment)	Yes	Heavy
5-35H5 (5-425L)	Engineer Battalion, Corps, Wheeled Engineer Battalion, Corps, Wheeled)	Yes	Heavy
5-195H5 (5-445L1)	Engineer Battalion, Corps, Airborne* Engineer Battalion, Corps, Airborne*)	Yes	Airborne
5-54H3 (5-443L1)	Engineer Company, Light Equipment, Airborne* Engineer Company, Light Equipment, Airborne*)	Yes	Airborne
5-54L2 (5-443L2)	Engineer Company, Light Equipment, Airborne** Engineer Company, Light Equipment**)	No	Light
5-195L2 (5-445L2)	Engineer Battalion, Corps, Airborne** Engineer Battalion, Corps, Light**)	No	Light
*Airdrop versions			
**Load and unload versions			

Figure 5

quantities of equipment, and can be deployed by C-141B aircraft. These units were first proposed as alternate versions to existing airborne units, and so retained the word "airborne" in their title. However, in the L-series TOE version, their equipment was designed to be loaded and unloaded -- not to be airdropped. The new TOE designations in the 5-400L-series change the titles to represent the actual capability and missions of these units, both of which center on the support of the Army's new lightweight divisions. These two proposed light units should not be confused with the existing airborne units, which are also listed in Figure 5. These two existing airborne units are designed solely to support the 82d and 101st Army divisions.

c. All engineer EAD battalion equivalents are stated in future terms -- that is, they assume that modern mines and explosives, plus ACE and SEE equipment, will be available. Figure 6 illustrates how ESC determined battalion equivalents and equipment mixes for EAD units, based on the study

assumptions for SWA and Korea (the results of ESC's ELID and 9ID(MTZ) studies were already stated in terms of future battalion equivalents.) The conversion factors listed in Figure 6 were developed from the LID study's European scenario. That scenario contained both a future case excursion as well as an excursion using conventional explosives available today. The planning factors in the ELID study were based on standard engineer sources for fielded items; for developmental items, estimates were obtained from the US Army Engineer School.

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FORMULAS TO CONVERT CURRENT REQUIREMENTS TO THE FUTURE\*

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**METHOD I: BASED ON COUNTERMOBILITY WORKLOAD**

Current (conventional explosives) countermobility:		Future (new explosives) countermobility:
<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
Squad-hours	30%	Squad-hours
Truck-hours	50%	Truck-hours
Truck-hours	100%	SEE-hours

**METHOD II: BASED ON TOTAL SCENARIO WORKLOAD\*\***

Current (conventional explosives) scenario:		Future (new explosive) scenario:
<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
Squad-hours	60%	Squad-hours
Truck-hours	90%	Truck-hours
Truck-hours	25%	SEE-hours

---

\*Source: ELID study data.

\*\*Less accurate than Method I.

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Figure 6

12. Latin America.

a. The terrain of Latin American does not favor the motorized infantry division and chances are low that it would be deployed to that theater. Therefore, only engineer EAD requirements for the LID were considered. Figure 7 shows these requirements, as extracted from ESC's ELID study. Only one light corps battalion is required per LID for the sustainability force. However, the study shows these requirements begin with offensive combat operations that follow the initial defense. In the scenario used by ESC, the light corps battalion was required by the fifth day of deployment.

LATIN AMERICAN THEATER (Engineer Battalion-Equivalents)	
<u>LID Force</u>	<u>Engineer unit*</u>
Crucial-combat force:	1 LID battalion
Sustainability force:	1 light corps battalion
Total engineer force (battalions):	2
*Source: ESC ELID study.	

Figure 7

b. For engineer requirements within the division area, the force structure allocation rule for this theater is one engineer light corps battalion per LID. This EAD battalion is technically part of the sustainability force, but should be considered for early deployment. This EAD unit should be light because the contingency theater's units will be moved and resupplied by air. The concept of operations for the LID in the Latin American theater does not consider prolonged combat operations past the scenario's 10 days of combat. If operations were lengthened, additional engineer forces would be required to

accomplish the extended peace-keeping support and security mission. While the focus of the LID study and this report is toward the future, the LID study contained an excursion which assumed only conventional mines and explosives are available to the division. That excursion indicated that support from an additional engineer light corps battalion will also be required.

13. Korea. In Korea, the 9ID(MTZ) and light divisions are best suited to the rough forested terrain typical of the interior of the peninsula. Figure 8 shows the engineer EAD force for this theater, as extracted from ESC's Korea study. That study's resolution is at the corps level, so separate data are not available for the motorized versus the light division.

KOREAN THEATER  
(Engineer Battalion-Equivalents)

Force	Engineer Unit*		
	High-Use	Low-Use	Average
Crucial-combat force:	LID/motorized battalion	--	LID/motorized battalion
	3 corps battalions	--	2 corps battalions
	1 heavy Battalion	--	--
Sustainability force:	CSE Company	--	2 CSE companies
	Heavy battalion	LID/motor- ized battalion	--
Total engineer force (battalions):	6+	1	3+

\*Source: ESC Korea study.

Figure 8

a. The averages shown in Figure 8 do not include any armored division requirements, but do show two different situations. The high-use situation occurred before the low-use situation. Both situations reflect

commitment after a normal deployment and adequate training time before combat employment.<sup>7</sup> Given the collective nature of this scenario, the average situation EAD force of two-plus battalions (three-plus counting the divisional battalion) is representative. However, a single wheeled corps engineer battalion could be substituted for the two CSE companies recommended.

b. The force structure for this theater does not include a light corps battalion for either the LID or 9ID(MTZ). The engineer EAD force structure required for lightweight divisions in Korea is estimated at three battalion equivalents, two of which should be the wheeled corps engineer battalion. The third battalion equivalent can be a heavy battalion, two CSE companies, or a third wheeled corps engineer battalion.

14. Southwest Asia. In the SWA theater, both the LID and 9ID(MTZ) are candidates for deployment. Figure 9 shows the engineer EAD force for each of these divisions, as extracted from previous ESC studies.

a. The engineer EAD force required for the LID is quite similar to the force required for Latin America. This should be expected, as the LID is employed in underdeveloped countries with closed terrain in both theaters. The crucial-combat force only requires the organic LID engineer battalion. The sustainability force requires a light corps engineer battalion of equipment, plus one-and-one-half battalions of squad power (27 squads). Additionally, slightly over one light equipment company is also required. However, if the equipment mix of the light battalion were to reflect only the highest priority combat engineer support missions (as recommended in the next section), then the light equipment company could be removed.

b. The engineer EAD force for a motorized division is quite extensive. Eight battalion equivalents are required for the crucial-combat force, and nine additional equivalent battalions are required for the sustainability force -- a total of 17 battalions, of which 16 are EAD units. Of the crucial-combat force, ESC concluded that two light engineer units plus one corps battalion (wheeled) were required to be deployed immediately by air. The rest could all be transported by sea.

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<sup>7</sup>Further unclassified comment is not possible. See Engineer Assessment, Korea: Forward Combat Zone Analysis for more information.

SWA THEATER  
(Engineer Battalion-Equivalents)

Force	Engineer Unit	
	LID*	9ID(MTZ)**
Crucial-combat force:	LID battalion	Motorized battalion Light corps battalion 5 corps battalions 2 CSE companies 1 light equipment company
Sustainability force:	1 light corps battalion (+) 1 light equipment company (+)	5 corps battalions 13 CSE companies
Total engineer force (battalions):	3	17+

\*Source: ESC EASWA study.

\*\*Source: ESC 9ID(MTZ) study -- assumes regional conflict (no global war) with large AO (150 by 200 km).

Figure 9

c. The unrealistically large AO assigned to the motorized division accounts for the numbers noted above and in Figure 9. In the SWA study, the 9ID(MTZ) AO was between 150 and 200 kilometers wide and 200 kilometers deep. This extremely large division area is normally defended by up to five divisions in a typical European defense scenario. The large workload requirements derived primarily from mobility and countermobility tasks are directly related to the size of this AO. In addition, the size of the threat force and the operational concepts the scenario writers employed for the 9ID(MTZ) significantly affect the computed requirements. That concept called for extensive mining by US Army engineers to prevent the threat from chasing raiding motorized elements and to protect the next motorized fallback position. It should be noted that if this large engineer force were deployed, and if the SWA war

expanded from a regional war into a global conflict, the commitment of 16 engineer EAD battalion-equivalents to support the motorized division in SWA would be an unacceptable risk in view of total force requirements and worldwide priorities. Although the SWA scenario used in the engineer analysis of the motorized divisions was consistent with the one used in the concept evolution of the motorized division, it was extreme and tended to magnify engineer requirements. It now appears unlikely that the 9ID(MTZ) would be deployed to a large AO in SWA.

d. The ESC proposed force allocation rules for both the motorized and LID divisions include one light engineer corps battalion. The LID also needs a second light engineer corps battalion, unless one wheeled corps engineer battalion were available to substitute for both during the sustainability phase. However, for sustained motorized division operations, many additional engineer battalions are needed. The number of these EAD units that will be provided will depend on the size of the AO, the threat posed, and the acceptable risk their deployment will present to other theaters.

15. Europe. The 9ID(MTZ) and one or more LIDs could be committed to Europe if the conflict conditions presented by a NATO war dictate. The AO for either division would be smaller than in their preferred theater. For the LID, the terrain would be closed; for the motorized division, the terrain would be open. These divisions could also be used for rear area combat operations. However, a rear-combat mission has not been written into a scenario for wargaming. The scenarios used by ESC were gamed by ADEA for a motorized division in Europe and by the US Army Combined Arms Operations Research Activity (CAORA) for a LID in Europe, with both divisions assigned appropriate missions on the FEBA. Figure 10 shows the engineer EAD force for both divisions in Europe based on these two scenarios.

a. The LID only needs about one EAD engineer battalion for operations in Europe. However, this EAD engineer battalion is vital: ESC's LID study concluded that, for the division to survive, the LID required at least 3 days of battlefield preparation by a light corps engineer battalion before combat started. The light equipment company needed for the sustainability force was only needed because of an improper equipment mix in the light corps battalion. ESC determined that if the nine scrapers in the light corps

battalion were replaced with other equipment items that were more suitable for FCZ requirements, then the light equipment company would not be needed.

b. The engineer EAD force for the motorized division follows the same trends as the LID, but is substantially higher than the LID. Most of the force (over five engineer battalions) is required for the crucial-combat force.

EUROPEAN THEATER  
(Engineer Battalion-Equivalents)

Force	Engineer Unit	
	LID*	9ID(MTZ)**
Crucial-combat force:	1 LID battalion 1 light corps battalion	Motorized battalion 4 corps battalions 2 CSE companies
Sustainability force:	1 light equipment company	2 CSE companies
Total engineer force (battalions):	2+	6+

\*Source: ESC ELID study.

\*\*Source: ESC 9ID(MTZ) study.

Figure 10

Two CSE companies are required of the sustainability force. The 9ID(MTZ) study determined that one wheeled corps engineer battalion was needed during the preparation phase. The remainder of the crucial-combat force was required when the LID became engaged in combat.

c. The force structure allocation for a LID should include one light corps engineer battalion for Europe. The proposed allocation rule for the 9ID(MTZ) is more generous, and should include four wheeled corps engineer battalions. The fifth battalion can be equivalent to four CSE companies or perhaps even one combat heavy engineer battalion. Both the LID and the 9ID(MTZ) require the support of one EAD engineer battalion during the preparatory phase before combat to prepare the battlefield. For the LID, this EAD

support unit should be the fast-deployed light corps battalion. For the 9ID(MTZ), it should be a reassigned, forward-deployed wheeled corps battalion.

16. Theater Allocation Rules. Figure 11 summarizes the proposed theater allocation rules developed by this study using units as currently organized. The large requirement for earthmoving equipment drives the demand for CSE companies. The number of CSE companies could be reduced if that company contained a better mix of the types of equipment required to accomplish tasks forward of the division rear boundary. Additional reductions may be possible if the equipment mix of the wheeled and light corps engineer battalions are improved as recommended in ESC's source studies and in the next section. No reduction in corps engineer battalions of either the wheeled or light version is possible because of the verified need for squad power. The rapid-response needs of the Army's new lightweight divisions are most pronounced in underdeveloped areas such as SWA and Latin America.

PROPOSED THEATER ALLOCATION RULES FOR ENGINEERS  
(EAD Battalions\*)

Theater and Engineer EAD Units	Total EAD Battalions by Type of Division	
	LID	9ID(MTZ)
SWA:		
Light corps battalion	1+	1
Wheeled corps battalion	--	10**
CSE equipment company	--	15**
Light equipment company	1	1
Korea:		
Light corps battalion	--	--
Wheeled corps battalion	2	2
CSE equipment company	2	2
Latin America:		
Light corps battalion	1	NA***
Europe:		
Light corps battalion	1	--
Light equipment company	1	--
Wheeled corps battalion	--	4
CSE equipment company	--	4

\*Required forward of each division rear boundary.

\*\*Assumes regional conflict (no global war) with large AO (150 by 200 km).

\*\*\*If sent to this theater in an economy-of-force mission, it can be extrapolated that the 9ID(Mtz) would require one light corps battalion.

Figure 11

#### IV. A NEW LIGHT ENGINEER BATTALION

17. General. This section examines the design requirements for a new battalion-sized light engineer unit. As shown in Figure 12, there are almost no company- or battalion-sized light engineer units in the current force structure. The top portion of the Figure 12 shows that the existing force structure has a large number of heavy engineer units that provide construction and combat support to the Army's armored and mechanized infantry divisions or to areas behind the division rear boundary. It also has a few light airborne units that provide rapid-deployment construction support (these units are listed in the lower left-hand corner of the figure); a typical construction mission is a theater-of-operations airfield for an airborne or even an air assault division. Although these airborne units have the squad power to perform combat support missions, this manpower is reserved for their primary construction missions. USAES has recognized the need for dedicating light combat engineer support units to the growing number of lightweight combat divisions, and has drafted two organizational proposals. These proposed load-and-unload units, listed in the lower right-hand corner of the figure, are designed to support lightweight divisions, but none will be activated before 1992. Instead, the Army plans to activate three more engineer airborne battalions and company sets (totaling five sets) to support LIDs by 1992. A close examination by ESC at the composition of light airborne units (i.e., the units listed in the lower left-hand corner of Figure 12) revealed that the structure of these two units has essentially been repeated for lightweight units (i.e., the units listed in the lower right-hand corner of Figure 12). The reasonableness of the proposed TOE designs and activations will be the focus of the analysis presented in this section.

18. Design Criteria. The design criteria for a new light engineer battalion, as outlined below, was derived from the results of ESC's earlier studies of the LID and motorized divisions. Each of those studies analyzed the equipment-mix of the dominant five pieces of equipment engineers use to support forces forward of the division rear boundary. The ACE, SEE, grader, loader and dump truck are the dominant engineer equipment. The unit equipment-mix is the percentage that each of these five equipment pieces represent in a unit's total equipment inventory; the requirement equipment-mix is the percentage of the

total scenario requirements satisfied by each of those pieces of equipment. ESC evaluated the capability of supporting candidate engineer EAD units compared to the scenario requirements after the requirements were reduced by the amount of capability available and satisfied by the organic division engineer battalion. Dominant equipment requirements and mixes reflect tasks generated under all the priority groups listed in Figure 3: vital, critical, essential, necessary.

#### ENGINEER EAD MISSION PROFILE MATRIX

Mission Profile	Engineer Mission					
	Construction			Combat Support		
	Unit	TOE	Quantity	Unit	TOE	Quantity
Heavy units:						
Slow deployment	Heavy			Corps		
High capability	battalion	5-115	47	combat		
(support armor &	Construction			battalion	5-35/45	61
mechanized infantry	support			CSE		
divisions OR areas	company	5-114	10	company	5-58	24
behind division						
rear boundary)						
Light Units:						
Fast deployment	Corps			Light corps		
Moderate capability	airborne			battalion	5-445	***0
(support airborne,	battalion	5-195	*2	Light		
air assault, light,	Light equip-			equipment		
& motorized	ment company,			company	5-443	***0
divisions)	airborne	5-54	**2			

\*These are the 27th and (in 1987) the 37th Corps Airborne Battalions; they can provide combat support to lightweight or motorized divisions, but only by sacrificing their own construction missions.

\*\*The 618th Light Equipment Company, Airborne, and a second unit will be activated in 1987.

\*\*\*Load-and-unload TOEs; no units activated to date.

Figure 12

a. A two-step process determined an "ideal" equipment-mix percentage for the engineer EAD units needed to support the lightweight divisions.

(1) In the first step, ESC calculated the equipment-mix percentage of each equipment type for each division. These percentages are the median percentage of each theater of employment.

(2) The second step compares the "ideal" median equipment mixes for the motorized division to the LID's "ideal" median as obtained in step one. If these two mixes are similar, they are averaged to obtain a composite equipment-mix percentage. The goal of the two-step process is the hopeful averaging of the two "ideal" division median percentages equipment-mixes into one composite equipment-mix that then can be supported by a single engineer EAD unit. If the two median "ideal" equipment-mixes are very dissimilar, then the goal cannot be reached and two engineer EAD units must be used or designed for the separate mixes.

b. A maximum size for each unit was established based either on the total number of C-141B sorties required to deploy the unit or on the total number of self-propelled engineer vehicles in the unit's inventory. The companies and the battalion could not be made larger than existing divisional lightweight units (Figure 4).

c. The criteria for the size and characteristics of battalions and companies were based on satisfying the high-priority shortfalls identified in ESC's previous studies. These shortfalls were experienced in the crucial-combat category and needed to be satisfied from D+4 to D+10 in a rapid-response scenario. Despite the importance of this shortfall, not much equipment was needed (mostly bulldozers and trucks) to satisfy the shortfall. Therefore, the units should be small so that they can rapidly deploy to a crisis area and so that they can satisfy the highest priority tasks.

19. Light Corps Engineer Battalion. Figure 13 shows the equipment-hour mix calculated by ESC for the LID and the 9ID(MTZ). The results differ by up to 15 percent, but in general are remarkably similar. In all cases, the predominant need is for bulldozer capability and hauling. The similarities between the needs of the two divisions are great enough to recommend that a single EAD unit be configured to support both. When ESC applied its the two-step design criteria, it merged the median equipment-hour values into one recommended value. Thus, the recommended equipment mix for the light corps

engineer battalion is 35 percent each for ACEs and 5-ton trucks, 15 percent for loaders, 10 percent for SEEs, and 5 percent for graders.

EQUIPMENT-HOUR MIX  
(Percentages\*)

Requirements	D-7/ ACE	Loader	Grader	Truck	SEE/ JD410
Motorized division:					
Southwest Asia	45	16	10	28	1
Europe	41	31	1	27	--
Korea (now)	49	12	13	26	--
Korea (future)**	47	11	13	23	6
Recommended median:	45	15	10	25	5
Light infantry division:					
Latin America	39	8	2	34	17
Southwest Asia (now)	17	21	1	60	1
Southwest Asia (future)**	16	19	1	50	14
Europe	25	16	6	42	11
Korea (now)	49	12	13	26	--
Korea (future)**	47	11	13	23	6
Recommended median:	30	15	5	40	10
Light corps battalion					
Recommended composition:	35	15	5	35	10

\*Percentages based on total requirement, less divisional engineer battalion capability.

\*\*See Figure 6 for conversion factors.

Figure 13

a. Figure 14 shows three sample designs for a light corps engineer battalion using the recommended composite equipment-hour mix. Two of the three designs use an equipment total from comparable TOEs prepared by the US Army Engineer School; the third is an ESC-proposed design that contains only 60 items of equipment. All three recommended designs improve performance. They differ only in size and, consequently, in the number of C-141B sorties needed

for deployment. All three designs also contain a minimum of a combined total of 40 bulldozers and trucks.

b. Figure 14 shows representative squad totals, ranging from 16 to 24 per battalion and the densities of key equipment items in the battalion. It

#### LIGHT CORPS BATTALION DESIGNS

	Equipment Items						
	AAF	D-7/				SEE/	
	Equip <sup>a</sup>	ACE	Loader	Grader	Truck	JD410	Total
Current USAES TOE units:							
Light corps battalion (18 squads): <sup>b</sup>							
Number	12	17	12	9	14	18	82
Equipment %	15	20	15	11	17	22	100
Airborne corps battalion (18 squads): <sup>c</sup>							
Number	14	13	10	8	24	3	72
Equipment %	20	18	14	11	33	4	100
ESC light corps battalion options:							
Option A (24 squads): <sup>b</sup>							
Number	--	29	12	4	29	8	82
Equipment %	--	35	15	5	35	10	100
Option B (18 squads): <sup>c</sup>							
Number	--	25	11	4	25	7	72
Equipment %	--	35	15	5	35	10	100
Option C (16 squads): <sup>d</sup>							
Number	--	21	9	3	21	6	60
Equipment %	--	35	15	5	35	10	100

<sup>a</sup>AAF equipment - Army airfield equipment: 9-cubic-yard scrapers, 1,500-gallon bituminous distributors, and 2,500-gallon water distributors.

<sup>b</sup>TOE 5-195L200 (has 82 items of construction equipment).

<sup>c</sup>TOE 5-195H500 (has 72 items of construction equipment).

<sup>d</sup>ESC candidate proposal.

Figure 14

also compares the three sample designs with the same two US Army Engineer School TOEs that both have 18 squads. The two TOEs are for an existing unit (the 27th Airborne Corps Battalion) and a proposed unit (the load-and-unload light corps battalion). These USAES TOEs include airfield construction equipment intended for tasks that this study excluded as not being part of the combat support mission. Note that the three sample solutions require from 21 to 29 ACEs per battalion. ESC did not evaluate the need for a bulldozer transportable by helicopter. If such a requirement exists, then some of this battalion's ACEs should be traded for bulldozers light enough to move by helicopter.

c. The truck required for this battalion is needed more for hauling Class V explosives than for providing fill materiel. ESC's ELID study recommended that a combination truck with a larger surface area be adopted to increase the unit's Class V haul capability. Figure 15 shows a 7.5-ton truck used by the Republic of Germany's army. This truck combines cargo and dump functions into one; it also dumps to both sides as well as to the rear. The General Motors Corporation is also designing a palletized dump truck that also has more cargo space combined with a hook-arm concept to load and unload pallets.

#### COMBINATION CARGO-DUMP TRUCK

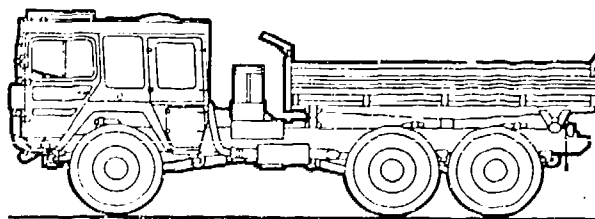


Figure 15

d. Figure 16 shows three squad options for the company organic to the proposed light corps battalion. All three options consider only two companies. ESC's analysis of a LID's requirements under several scenarios indicated that a reinforcing engineer unit was required to provide four squads

(of seven to eight men each) at D+4, eight squads at D+8, and 18 squads at D+10. Without additional manpower, the LID engineers would be unable to complete all tasks in the essential priority group.

e. ESC's LID analysis also showed that the 5-ton trucks required for hauling could be centralized into one or more equipment companies. To make up for the loss of trucks as potential ground transportation, ESC recommends using the HMMWV as a squad vehicle. (Although the LID concept of operations stresses walking or using helicopters to relocate engineers, a walking EAD unit cannot respond to widely dispersed missions on the battlefield, and helicopters are usually not available for EAD missions.)

#### LIGHT CORPS COMPANY DESIGNS

	Option		
	A	B	C
Number of companies	2	2	2
Platoons per company	3	3	4
Number of platoons	6	6	8
Squads per platoon	4	3	2
Number of squads	24	18	16
Squad vehicle	HMMWV	HMMWV	HMMWV
Squad size	7	8	8
Total squad personnel	168	144	128

Figure 16

f. Figure 17 is the engineer light corps battalion proposed by ESC. This unit incorporates the 60 items of equipment proposed for option C of Figure 14 and the 18 squads proposed for option B of Figure 16. The other options provide equipment and manpower not needed for the crucial-combat tasks or for the period of time beyond D+10, and are therefore excess to the criteria established for this unit. The recommended option has fully met the design criteria of paragraph 18 and will give the battalion a total of four companies: two squad-only companies, and two equipment-only companies. These four companies can be sequenced for deployment depending on the most urgent scenario requirement -- manpower or equipment. This configuration would also create a unit of fewer than 500 individuals that could be transported in 50 or less C-141B sorties -- a truly light, fast-deploying unit. This unit also has the

capabilities, when combined with the divisional battalion, to complete most crucial-combat divisional tasks. Details other than those shown in Figures 15 through 17 are beyond the scope of this monograph and are left to the TOE developer.

## PROPOSED LIGHT CORPS BATTALION DESIGN

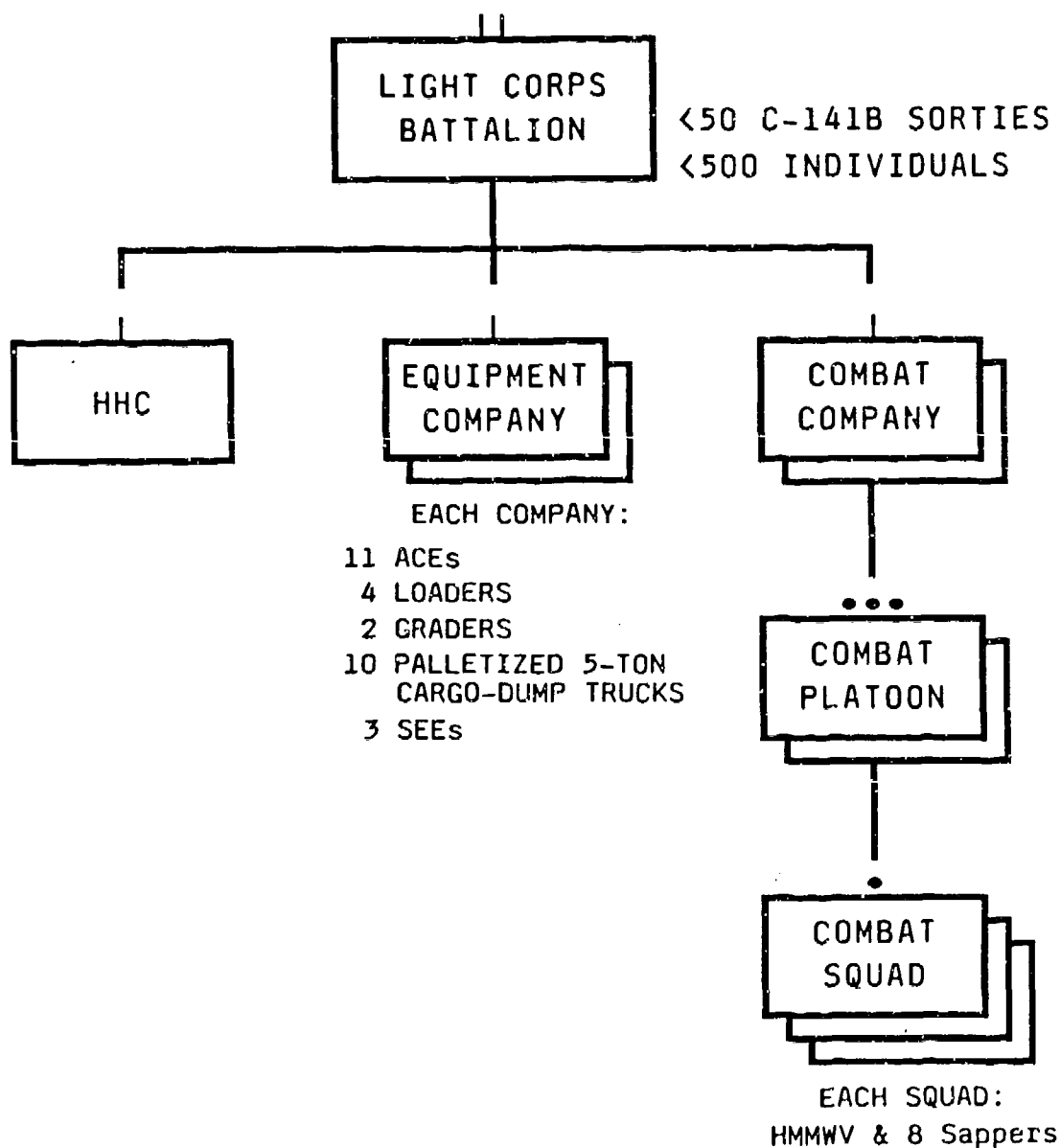


Figure 17

## V. EAD BRIDGING REQUIREMENTS

20. General. This section presents, for all theaters, alternatives for providing EAD bridging support to light and motorized forces. Bridging capability and requirements were analyzed separately in ESC's earlier studies of lightweight forces; therefore, bridging capabilities were not discussed in Section III or considered in the allocation rules shown in Figure 11. The source studies usually treated bridging as a special topic outside the main study methodology, as did this analysis. As in previous sections, this analysis will examine the bridging requirements within the division AO that are provided from engineer EAD units. This section summarizes the source studies bridging findings, evaluates three EAD bridging alternatives, and presents proposals for a light bridge detachment.

21. Theater Bridge Findings. The results of ESC's past and ongoing analyses of the Army's new division concepts do not indicate any clear preference for a particular type, or need, for bridging support. It appears that bridging for lightweight divisions depends on the answers to three questions. The answer to the first question can be partially quantified from the scenario conditions: "What are the actual requirements in terms of the size, type, frequency, and location of gaps to be crossed?" The answer to the second question depends a great deal on battlefield conditions: "How long can a unit wait to begin a gap-crossing task?" The final question is also battle-dependent: "How long can the unit take to complete the gap-crossing task?" (The last two questions were not considered in ESC's earlier analyses of the bridging requirements of lightweight forces.) If a value can be assigned to the responses to each of these questions, then decisions can be made about the type and quantity of bridges and whether to place them in the division or corps.

a. While this section is concerned with EAD bridging, the analysis first considers divisional bridging to determine the amount of bridge requirements a division cannot meet using its own capability. The shortfall translates to a need for EAD bridging support.

(1) The only light bridging proposed by the US Training and Doctrine Command (TRADOC) for lightweight forces is for the motorized division. The Light Assault Bridge (LAB), now in development, will be a self-contained

trailer which can be transported and launched using the ACE or any 5-ton truck. The LAB is a class-30 bridge and is 23 meters long.

(2) ESC's 9ID(MTZ) study concluded that the division would require two LAB bridges in Europe, but none in SWA. The need for bridging in Europe occurs during the retrograde and could have been met by an engineer EAD bridge unit. The SWA terrain was open, and had few gaps that could be bypassed with organic divisional vehicles. The 9ID(MTZ) study recommended using four LAB bridges instead of the 10 proposed in the TOE. The scenario area within the SWA theater again had no requirements for MSR bridging but in Europe, many gaps were spanned using EAD Bailey bridge units. The 9ID(MTZ) study also proposed that future EAD engineer TOEs include some small-gap crossing capability to augment the divisional engineer LABs.

b. In the ELID study, ESC recommended a new lightweight bridge be developed for an EAD platoon-sized unit. (The LID organic engineer battalion has no bridging capability.) ESC recommended using a bridge that could span either dry or wet gaps, and could be transported by C-141B aircraft and unit vehicles. The report also suggested that LID bridging be over 40 meters in length, and be easy to erect. The bridge is needed primarily to maintain main supply routes (MSRs) for resupply between division/corps supply areas and brigade supply areas (including separate artillery bases). For the current time frame, the ELID study recommended depot-stocked M4T6 bridging sets be made available.

c. ESC's Korea study only evaluated wet gaps wider than 18 meters. The study assumed that the few dry gaps encountered could be bypassed or crossed using expedient methods. For wet gaps over 18 meters, this study estimated requirements for hasty river crossings and concluded that either a few light rafts or many assault boats would be needed. This study recommended that the engineer EAD ribbon bridge company be augmented by 15-man assault boats and light tactical raft sets to satisfy LID bridge requirements. This solution was feasible in the Korea study because the scenario deployed US divisions in a corps containing both light and heavy divisions, and provided time for existing EAD bridge units to arrive.

d. In the SWA study, ESC evaluated MSR gaps leading into a LID AO. The scenario was similar to that of Korea in that a corps with light and heavy divisions was deployed and time was allowed for EAD bridge units to arrive.

This study recommended that all EAD Bailey bridge units convert to EAD medium girder (MGB) bridge units.

22. Three Bridge Alternatives.

a. The first EAD bridge alternative adds 15-man assault boats and light tactical rafts to existing ribbon bridge companies. This alternative was proposed in the Korean study and is also applicable to the SWA theater where a corps containing a mix of light and heavy divisions is employed. The advantage to this alternative is that, by modifying existing units, no new units have to be designed and activated. The primary disadvantage is that it does not meet the needs of a single motorized or light infantry division responding to a crisis in an underdeveloped country.

b. The second alternative is the status quo. This alternative uses existing EAD bridge units that enable resupply vehicles to cross damaged MSRs. ESC studies determined this alternative would be acceptable in Europe and in SWA when there was no threat of a global war following a SWA war. The status quo, however, does not mean that bridge modernization should be stopped; the goal to eventually replace all EAD Bailey bridge companies with MGB companies remains valid. This alternative has the same advantage and disadvantage of the first EAD alternative.

c. The third alternative creates a new EAD light bridge detachment. (Under the lightweight division doctrine, this detachment would probably be called a company, and have a captain as commander.) This alternative was recommended in the two division-level ESC studies. The primary advantage of this alternative is that it responds to a crisis in an underdeveloped country. The disadvantage is that a new TOE must be designed and a new units fielded. This alternative has two versions -- one for today and one for the future. If selected, this alternative would require both versions be designed into a "living" TOE (this is the purpose of the L-series TOEs now gradually being implemented).

(1) The current version of alternative 3 uses fielded bridge items. Candidate bridge items for this version include 15-man assault boats, an aluminum footbridge, a light tactical raft, a M4T6 bridge, and the MGB.

(2) The future version of alternative 3 incorporates developmental bridging similar to the LAB or other yet to-be-determined concepts.

23. Light Bridge Detachment. The light bridge detachment is a conceptual unit designed to satisfy the requirements for alternative 3.

a. One design criterion for this detachment was size -- ESC limited it to three C-141B airplane loadings. Seven-and-one-half sorties are required to move the divisional TOE proposed assault bridging of the motorized division (10 LABs and 10 trucks). However, the lesser ESC-recommended amount of four LABs requires just three C-141B sorties. The three sorties are part of ESC's second criterion, which asks that the bridge double in both an assault and a sustainment role. This sortie criterion is economical, yet permits EAD engineer units to replace the motorized divisional bridging if doctrine changes in the future. In ESC's LID study, the scenario contained requirements for one 40-meter gap. Three C-141B loadings will provide at least twice that scenario's crucial-combat bridging requirement (i.e., 80 or more meters of bridging). The detachment design is presented in three parts -- parts A and B each fill two and one-half C-141B airplanes. Part A is for the future, while Part B is for today; Part C fills one-half of a C-141B airplane and uses existing equipment for both today's version and the future TOE version. (Part A + Part C = future TOE; Part B + Part C = today's TOE.)

(1) Part A. For the future version, this unit would use the LAB or some future concept that could employ trestle-piers, foam floats, and so forth. ESC recommends using four LAB trailers and two combination cargo-dump 5-ton trucks in this unit. These six items would fill two and one-half C-141B aircraft. This unit would not have to be 100-percent mobile, since the ACE from the organic motorized divisional battalion would provide transport when the LAB bridge is used forward. For MSR repairs in the rear, the unit would either shuttle trailers or borrow any 5-ton truck.

(2) Part B. For the current time frame, ESC recommends using one set of M4T6 bridge modified to fit into 10 bridge trucks. This configuration also fits into two and one-half C-141B airplanes. As described in the LID study, this bridge has the flexibility to span either dry- or wet-gaps. The set can make two rafts or 43.2 meters of bridge. (It should be noted that this does not provide the desired 80 meters of bridging capability. However, this interim solution could be expanded to include two sets of M4T6 bridge.)

(3) Part C. The aluminum footbridge is proposed for the remaining one-half of a C-141B load in both the future and present detachment

TOE versions. One set (144 meters) of floating aluminum footbridge can be placed on two 2.5-ton trucks. These two trucks will fill one-half a C-141B aircraft. ESC believes that one set of aluminum footbridge (loaded on two 2.5-ton trucks) has promise for the proposed detachment, since a set also can be used for 30 meters of light vehicle bridge (or even three light vehicle rafts).

b. Both the present and future light bridge detachment versions would be entirely transportable in three C-141B aircraft. Final decisions about the configuration of a light bridge detachment must be made carefully, and the best available bridging equipment should be selected considering bridges of all US services and of our allies.

24. Theater Allocation Rules. One light bridge detachment is needed for contingencies that deploy a lightweight division to an underdeveloped country during the start of the crisis. Such areas include SWA and Latin America. Lightweight divisions deployed to Europe or Korea will not require a light bridge detachment, since either heavier in-country corps bridging is available, or CONUS bridging can be deployed in time.

## VI. FINDINGS

25. Compilation of Results. This report first analyzed allocation rules based on existing unit designs. Unit design changes to the light corps battalion were then recommended that would more closely align the units' capability with a full range of theater scenario requirements. This paragraph addresses the adjustments to the allocation rules that could be made if those design changes were made, and presents revised total-force recommendations for EAD light units.

a. The proposed light corps battalion design has several organizational improvements that enhance the unit's effectiveness.

(1) The two key equipment items -- bulldozers/ACEs and trucks -- are increased. The bulldozers are increased 30 percent from the old TOE and 100 percent from the new TOE. Five-ton trucks are increased 50 percent from either the old or new TOE. (NOTE: neither the old nor new TOE has ever been fielded; see Figure 5.)

(2) The unit's inventory of equipment with lower utilization rates, such as loaders, graders, and SEEs, is reduced.

(3) A dozen items of specialized equipment -- scrapers and distributors -- are deleted. These items (plus towed rollers that are also deleted but not listed in Figure 14) are designed for constructing army airfields. Such construction is not part of the lightweight division concept.

(4) The proposed battalion has divorced manpower from equipment by forming two companies of each. This allows planners to sequence company deployments that satisfy the most urgent theater need. For example, the LID needs manpower first in Latin America, while the 9ID(MTZ) needs equipment first in SWA.

(5) The net effect of the changes outlined above is a battalion that is small and responds easily to a crisis scenario. At the same time, the battalion has the needed equipment and manpower to accomplish the crucial-combat tasks that are beyond the capability of each division's organic engineer battalion.

b. The organizational improvements contained in the proposed light corps battalion eliminate the need for the light equipment company (TOE 5-443) that is included in Figure 12 as a fast-deployment option for supporting the

combat mission of lightweight forces. This company was needed in the source ESC studies to provide bulldozers/ACEs and trucks. But by increasing the inventory of bulldozers/ACEs and trucks, the battalion no longer needs a separate equipment company. The light equipment company TOE presently is a "leg" version of the airborne company. The airborne company's mission is to provide equipment to the airborne division's engineer battalion, so both can jointly construct army airfields. The airborne battalion's mission is to construct army airfields independently. Neither the airborne mission, nor the relationship of allocating one company per battalion, apply to the missions for lightweight divisions. None of these proposed companies (TOE 5-443) are scheduled for activation through 1992; ESC sees no need to activate any.

c. This study recommends changes for the 1990s. ESC assumes the proposed light corps engineer battalion will be available by that time, and will have more bulldozers/ACEs and trucks than current units. (This battalion absorbs the requirement for the light equipment company.) Other changes are scheduled, including the introduction of the ACE. The ACE will add bulldozer blades to the CSE company and wheeled corps engineer battalion. Other changes to engineer EAD units are also possible, but cannot be predicted now. Based on the uncertainty of future changes and the exact composition of future units, ESC would rather state allocation rules in terms of just light corps battalions (as proposed by ESC) and other engineer battalion-equivalents. A battalion-equivalent is either a wheeled corps engineer battalion or three CSE companies. This nomenclature allows planners to adjust forces based on final TOE designs. Figure 18 shows the revised theater allocation rules derived from Figure 11, using engineer battalion-equivalents.

d. At the beginning of this report, it was explained that the limitation on using classified operation plans prevented showing how ESC calculated the total number of theater engineer units required for any specific theater. However, for the engineer units proposed by ESC, it is possible to give a total force structure recommendation.

(1) The engineer force structure needs four light corps engineer battalions of the type proposed by ESC. Many combinations of various global scenarios were tested and the result was always that four, and occasionally five, battalions are needed.

PROPOSED ENGINEER EAD ALLOCATION RULES  
(Number of Battalions\*)

<u>Division and Theater</u>	<u>Proposed Light Corps Battalion</u>	<u>Other Engineer Battalion- **</u>	<u>***</u>
LID:			
SWA	1	--	
Latin America	1	--	
Europe	1	--	
Korea	--	3-	
9ID(MTZ):			
SWA	1	15***	
Latin America	--	--	
Europe	--	5+	
Korea	--	3-	

\*Required forward of the division rear boundary.

\*\*One wheeled corps engineer battalion or three CSE companies.

\*\*\*Assumes regional conflict (no global war) with large AO (150 by 200 kilometers).

Figure 18

(2) ESC calculated a firm requirement for three light bridge detachments. This was essentially based on the risk of participating in up to three deterrent actions at one time. It is possible that additional detachments are required as more specific operations plans are developed for contingency areas.

(3) ESC cannot endorse the activation of three more corps airborne engineer battalions (TOE 5-195/445) and three more light equipment airborne companies (TOE 5-54/443). These activations are scheduled for 1990-92 and should be replaced by activations of the four light corps engineer battalions proposed in paragraph 25d(1) above.

26. Conclusions.

a. The Army's new lightweight divisions need EAD combat engineer support.

b. Existing EAD engineer units in the total force can meet the sustainability or follow-on requirements of lightweight forces.

c. The current design of fielded EAD units cannot meet the rapid-response, crucial-combat requirements of lightweight forces.

d. Existing bridges and trucks of the engineer EAD force do not satisfy the mobility requirements of lightweight divisions.

27. Recommendations.

a. The time-phased force deployment lists (TPFDL) that include the new lightweight divisions should include engineer EAD units in accordance with the allocation rules shown in Figure 18. These engineer EAD units are required to provide engineer support forward of the division rear boundary. They include:

(1) For the LID, about three engineer battalion-equivalents for Korea using the wheeled corps battalion and CSE company.

(2) For the 9ID(MTZ), three to 15 engineer battalion-equivalents for SWA, Korea, and Europe, also using the wheeled corps battalion and CSE company.

b. The Army should design and field four light corps battalions (TOE 5-445), as configured in Figure 17. This unit would eliminate the need for the proposed light equipment company (TOE 5-443). The allocation rules for the light corps battalion are:

(1) For the LID, one battalion for each LID deployed to contingencies in SWA, Latin America, or Europe. These units should be used instead of the engineer airborne battalions (TOE 5-195/445) and companies (TOE 5-54/443) scheduled for activation for 1990-92.

(2) For the 9ID(MTZ), one battalion for contingencies in SWA.

c. The Army should design and field three urgently needed light bridge detachments using currently available inventory bridges.

d. The Army should acquire or develop two new items of equipment for engineer EAD units that support lightweight divisions:

(1) A combination cargo/dump palletized 5-ton truck.

(2) A combination assault/MSR bridge capable of spanning dry and wet gaps and being easily transported in C-141B aircraft.

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